RECEIVED
NOV 08 2018
EDMIC

1250487
[0064403H]

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
3100 Port of Benton Blvd • Richland, WA 99354 • (509) 372-7950
711 for Washington Relay Service • Persons with a speech disability can call 877-833-6341

November 6, 2018 18-NWP-175

Jan Bovier, Tank Closure Program Manager
Tank Farms Programs Division
Office of River Protection
United States Department of Energy
2440 Stevens Center, MSIN: H6-60
Richland, Washington 99352

Re: Department of Ecology's Comments on the *Performance Assessment of Waste Management Area C, Hanford Site, Washington* (DOE O 435.1 PA), RPP-ENV-58782, Revision 00

Dear Jan Bovier:

The Department of Ecology (Ecology) received the above referenced document, DOE O 435.1 PA, on October 25, 2016. The United States Department of Energy (USDOE) asked Ecology to defer submission of comments on the DOE O 435.1 PA until the document was made available for a public review period, which began on June 4, 2018. Enclosed are Ecology's comments on the DOE O 435.1 PA.

The DOE O 435.1 PA is one of four volumes that comprise the integrated Performance Assessment (PA) required by Appendix I of the *Tri-Party Agreement* (TPA) for Waste Management Area C (WMA-C). As stated in Section 2.5 of Appendix I, this integrated PA "is expected to provide a single source of information that DOE can use to satisfy potentially duplicative functional and/or documentation requirements."

As the TPA lead regulatory agency for the Single-Shell Tank System, Ecology is responsible for ensuring that all applicable requirements are met for successful completion of milestone M-045-00 ("Complete the closure of all Single Shell Tank Farms"). The PA for WMA-C is a key component of the *Tier 2 Resource Conservation and Recovery Act (RCRA) Closure Plan for Waste Management Area C*, RPP-RPT-59389, which is a TPA primary document. Accordingly, Ecology expects that the enclosed comments on the DOE O 435.1 PA will be resolved pursuant to the process set forth in TPA Action Plan Section 9.2.2, despite the postponed submission of Ecology's initial comments per USDOE's request.

We appreciate the effort USDOE has made to date in addressing our comments on the previous two volumes of the integrated PA for WMA-C. We look forward to completing the resolution of our comments on the remaining two volumes.

18-NWP-175

If you have questions or concerns, please contact me at jeff.lyon@ecy.wa.gov or (509) 372-7914, or Beth Rochette, Toxicologist, at beth.rochette@ecy.wa.gov or (509) 372-7922.

Sincerely,

Jeffery J. Lyon
Tank Systems Operation & Closure Project Manager
Nuclear Waste Program

br/aa
Enclosure

cc electronic w/enc:
- David Einan, EPA
- Christopher Kemp, USDOE
- Doug Shoop, USDOE
- Brian Vance, USDOE
- Jon Perry, MSA
- Marcel Bergeron, WRPS
- Paul Rutland, WRPS
- ERWM Staff, YN
- Ken Niles, ODOE
- Scott Van Verst, WDOH
- Jim Alzheimer, Ecology
- Mike Barnes, Ecology
- Damon Delistraty, Ecology
- Dib Goswami, Ecology
- Theresa Howell, Ecology
- Jeff Lyon, Ecology
- John Price, Ecology
- Beth Rochette, Ecology
- Maria Skorska, Ecology
- Mign Walmsley, Ecology
- Cheryl Whalen, Ecology
- Jerry Yokel, Ecology
- Environmental Portal
- Hanford Facility Operating Record
- MSA Correspondence Control
- USDOE-ORP Correspondence Control
- WRPS Correspondence Control

cc w/enc:
- Susan Leckband, HAB
- Administrative Record
- NWP Central File

cc w/o enc:
- Matt Johnson, CTUIR
- Jack Bell, NPT
- Alyssa Buck, Wanapum
- Rose Longoria, YN

Document number	Comment number	Section	page	lines, Figure or Table #	Primary Comment initiator	Secondary	Comment date	Comment	Basis	Recommendation	Ecology PM review	Comment Category	Comment Responder	Comment disposition date	Disposition	Comment Status	Status Details	Open or Closed
RPP-ENV-58782, Rev 0	OPAG1	General	General	General	BR		10/23/2018	Ecology provided comments on 3 documents related to this Performance Assessment; with this document they comprise the HFFACO Appendix I Performance Assessment. Two of the 3 documents were written to address radionuclides and nonradionuclides that were released to the soil/vadose zone as a result of various unplanned releases (UPRs), such as tank and ancillary equipment leaks and other spills and releases in, and associated with, WMA C, as well as hazardous waste associated with the tank residuals in WMA C. The comments were submitted by letter 17-NWP-085 from Jeff Lyon of the Washington State Dept. of Ecology to Chris Kemp of USDOE/ORP, on July 14, 2017. USDOE/ORP and their contractor and Ecology have been working on resolution of the comments attached to the above letter. Among our concerns are (1) contamination that is currently in the vadose zone from a variety of unplanned releases (including tank releases) in WMA C, which have and are currently contaminating groundwater, and the pressing need to mitigate and remediate this contamination throughout its residence time in the vadose zone and groundwater; (2) insufficient detail in site conceptual models for the vadose zone geology (for example, oversight of textural variability, fine layering, dipping strata, variability in sorption characteristics) and (3) lack of consideration of risks from soil contamination that was investigated in Phase I of the WMA C RCRA Facility Investigation, such as the large direct contact risks associated with 3 non-tank unplanned releases in WMA C, and other shallow contamination in zones that were too radioactive to sample.We acknowledge that USDOE is working with us for (2).	See the comments for further details on our concerns (1) and (2). Concern (3), the risks associated with the 3 large non-tank unplanned releases in WMA C (UPRs 200-E-81, E-82, and E-86), are described in a document that was attached to the WMA C Corrective Measures study.	Please consider sharing our concerns about the Appendix I PA with the Nuclear Regulatory Commission for consideration in the Waste Incidental to Reprocessing Determination.	JL							
RPP-ENV-58782, Rev 0	OPAG2	General	General	General	JL		10/23/2018	USDOE submitted the WIR to NRC, the Closure Plans and 4 volumes of the PA to Ecology, however USDOE did not provide information or complete the process, as required in Appendix H, Steps 2 & 3, and Appendix I Section 3.1 of the HFFACO.	HFFACO Appendix H states (in part): '2.b Establish an interface with the Nuclear Regulatory Commission (NRC), and reach formal agreement on the retrieval and closure actions for single shell tanks with respect to allowable waste residuals in the tank and soil column 3. Perform a joint assessment by DOE and Ecology of the retrieval goal, based on the inputs from steps 1 and 2. Modify the retrieval goal to match the most restrictive case (i.e., the highest retrieval % requirement).' Also, Appendix I, Section 3.1 requires achieving a cohesive approach to SST system closure and ensuring that all regulatory requirements are met.	Contact NRC for review of the retrieval and closure actions for SSTs including both tank residuals and soil contamination. Also, to be consistent with Appendix I Section 3.1, combine the WMA C contamination with upgradient vadose zone and groundwater contamination sources in the evaluation.This integration is best modeled in the TC and WM EIS at this time and should be a basis for evaluating WMA C contamination with that of the rest of the Central Plateau.	JL							
RPP-ENV-58782, Rev 0	OPAG3	General	General	General	BR	JL	10/23/2018	Though Ecology is submitting these comments during the public comment period for this document, Ecology, as the lead agency for the HFFACO for SST system closure, has a responsibility to ensure that CERCLA requirements for the radionuclides at WMA C are met.	See Section 5.6 of the HFFACO.	Please resolve these comments through comment resolution meetings with Ecology.	JL							
RPP-ENV-58782, Rev 0	OPAG4	General	General	General	BR		10/23/2018	This document needs to include a discussion about all of the source terms for the PA (vadose zone, tanks, pipelines, ancillary equipment, and groundwater) to put the tank component of the system in perspective relative to the other sources.	The tank residual component is not the most concerning component of WMA C. The past releases in the vadose zone and groundwater are much more immediate threats and need to be stressed in each of the PA documents so that they are addressed with the highest priority.	Include a discussion in the introduction about all of the source terms for the PA (vadose zone, tanks, pipelines, ancillary equipment, and groundwater) that puts the tank component of the system in perspective relative to the other sources.	JL							
RPP-ENV-58782, Rev 0	OPAES-1	ES	ES-7	33-36 and Figure ES-5 and Figure 6-1	DD		10/23/2018	It is not clear whether or not the exposure pathways/receptors specified (i.e., groundwater, air, inadvertent intruder) are the only pathways/receptors explicitly required by DOE Order 435.1.	A conceptual exposure model should be complete.	Please state whether or not the exposure pathways/receptors specified (i.e., groundwater, air, inadvertent intruder) are the only pathways/receptors explicitly required by DOE Order 435.1. Regardless of the DOE Order 435.1 requirement, acknowledge that there are other exposure pathways/receptors that have been omitted in Figures ES-5 and 6-1 . Also, please label the source term in these figures, "Residual Waste in Tanks and Ancillary Equipment" (rather than the less informative, "Waste Management Areas"). Please describe the associated uncertainty with this omission of a more comprehensive suite of pathways/receptors. At a minimum (and to provide context to Figures ES-1 and 6-1), please cite the BRA (RPP-RPT-58329, Rev. 2) and RCA (RPP-ENV-58806, Rev 0) in a footnote to Figures ES-1 and 6-1, as source documents for information on additional exposure pathways/receptors.	JL							
RPP-ENV-58782, Rev 0	OPAES-2	ES	ES-8	7-8	DD	CW	10/23/2018	No rationale is provided for the statement that the "receptor is assumed to reside 100 m downgradient of the WMA C fenceline" (rather than at the fenceline).	The requirement in O 435.1 is that "The point of compliance shall correspond to the point of highest projected dose or concentration beyond a 100 meter buffer zone surounding the disposed waste. A larger or smaller buffer zone may be used if adequate justification is provided." The "highest projected dose" was not defined and no justification was provided.	Provide rationale for POCs and define "highest projected dose."	JL							
RPP-ENV-58782, Rev 0	OPAES-3	ES	ES-8	8-10	DD		10/23/2018	Tanks waste contaminants in groundwater may be transported to the river and impact receptors in surface water and sediment in the Columbia River.	Contaminants may be transported to the river via a groundwater pathway.	Columbia River surface water and sediment should be included in the pathway overview (Figure ES-5).	JL							

RPP-ENV-58782, Rev 0	OPAES-4	ES	ES-8	18-23	DD		10/23/2018	Please clarify if these Kd thresholds (Kd>0.1 mL/g, Kd>1.5 mL/g) apply to the base case. Also, provide more details on the derivation of these Kd thresholds (i.e., identify "conservative recharge rates and hydraulic properties").	Adequate rationale for screening contaminants should be provided.	Provide underlying assumptions on recharge rates and hydraulic properties for deriving Kd thresholds used to screen contaminants.	JL							
RPP-ENV-58782, Rev 0	OPAES-5	ES	ES-10	Table ES-1	DD		10/23/2018	Footnote "d" does not directly apply to uranium, expressed in ug/L. Assuming a specific acitivity of 0.67 uCi/g for natural uranium, 0.05 ug/L converts to about 0.034 pCi/L (far above the level in foonote "d" [1E-10 pCi/L], considered essentially zero).	Performance standard for uranium is in units of ug/L, while footnote is in units of pCi/L.	Delete footnote "d" for uranium.	JL							
RPP-ENV-58782, Rev 0	OPAES-6	ES	ES-10	Table ES-1	DD		10/23/2018	If a recent EPA/OSRTI memo on uranium (which proposes a 15 fold decrease in RfD from 3E-3 to 2E-4 mg/kg-d) is adopted by MTCA, the new MTCA Method B CUL would be 3.2 ug/L, necessitating the downward adjustment of the MCL (30 ug/L) to Hanford background (10 ug/L).	https://semspub.epa.gov/work/HQ/196808.pdf	If MTCA adopts the recommendation in the Dec 2016 EPA/OSRTI memo on soluble uranium, the MCL for uranium will require downward adjustment to Hanford background.	JL							
RPP-ENV-58782, Rev 0	OPA1-1	1.1	1-6	3-6	DD		10/23/2018	Cite the most recent version of the BRA (RPP-RPT-58329, Rev 2).	Rev 2 is the most recent version of the BRA (Oct 2016).	Cite the most recent version of the BRA (RPP-RPT-58329, Rev 2).	JL							
RPP-ENV-58782, Rev 0	OPA1-2	1.3	1-16	22-28	BR		10/23/2018	The document discusses the 14 unplanned releases in WMA C. This contamination is outside of the tanks and migrating. The impacts will occurr sooner than those from in-tank contamination; Tc-99 contamination in groundwater in and around WMA C is well above the drinking water standard, due to the migrating contamination from tank releases. All of this contamination should be mentioned, and it will all require some form of rememdiation.	Figure 1-6 shows the location of the UPRs. The WMA C CMS gives estimates of risk associated with three of the largest non-tank UPRs (RPP-RPT-59379). Well contamination is given in SGW-60546 (December 2016 WMA C Quarterly Report). The WMA C Soil Inventory data package (RPP-RPT-42294) gives estimates of inventories for vadose zone contamination. The Past Leaks document (RPP-RPT-59197) gives vadose zone modeling results (scoping level) for WMA C vadose zone contamination.	In the paragraph on the 14 Unplanned Releases, cite the WMA C BRA, the WMA C CMS, the Past Leaks document, and the soil inventory data package.	JL							
RPP-ENV-58782, Rev 0	OPA2-1	2.4.4	2-9	36	SV		10/23/2018	Radon is omitted from the air pathway assessment.	Even if radon has its own specific performance objective, it can still be a component of the air pathway dose.	Explain why radon is omitted from the air pathway assessment.	JL							
RPP-ENV-58782, Rev 0	OPA3-1	3.1.5.3.1; 3.1.5.2	3-65 - 3-67		BR		10/23/2018	These sections need to include photos and a description of the thin lamina, bedding, and other heterogeneities that are known to exist in the vadose zone throughout Hanford.	Ecology has significant concerns about the influence of subsurface horizontal and vertical features on unsaturated flow. We have written letters to USDOE and provided comments on the Appendix I PA documents regarding this issue. We are unconvinced that this has been addressed adequately by models that do not incorporate the type of heterogeneities that are known to exist in the Hanford subsurface.	Please see Ecology's comments provided for the Past Leaks document and RCRA Closure document (RPP-ENV-58806) regarding subsurface heterogeneity and modify this document to be consistent with the resolutions for Ecology's comments on the other documents. Include photos and descriptions of subsurface heterogeneities in this document.	JL							
RPP-ENV-58782, Rev 0	OPA3-2	3.1.5.3	3-67 - 3-68	General	BR		10/23/2018	This section should include WMA C-specific information about unplanned releases, and refer the reader to RPP-CALC-61128, (attached to the WMA CMS (RPP-RPT-59379)) which discusses risk estimates for these releases.	The risks associated with the 3 large non-tank unplanned releases in WMA C (UPRs 200-E-81, E-82, and E-86) are described in a document that was attached to the WMA C Corrective Measures study (RPP-RPT-59379). The estimated risks from the released radionuclides at these locations are extremely high and far exceed any other risk value associated with WMA C.	Please mention the 3 large non-tank unplanned releases in WMA C (UPRs 200-E-81, E-82, and E-86) and cite the references RPP-CALC-61128 and RPP-RPT-59379.	JL							
RPP-ENV-58782, Rev 0	OPA3-3	3.1.8	3-85	43-46	DD		10/23/2018	Text cites NCRP Report No. 93 for an estimate of background radiation dose in the U.S. (365 mrem/y). NCRP Report No. 160 (2009) updates NCRP Report No. 93 (1987). A key finding of the more recent NCRP Report No. 160 is that although the naturally occurring amounts of radiation have changed little, there has been a dramatic increase in the amount of radiation from medical imaging procedures, resulting in an increase in background radiation dose to the general public in the U.S. (620 mrem/y).	NCRP Report No. 160 updates NCRP Report No. 93.	Revise the background radiation dose estimate (620 mrem/y), according to NCRP Report No. 160.	JL							
RPP-ENV-58782, Rev 0	OPA3-4	3.1.9.2.1	3-97	Figure 3-41	BR		10/23/2018	Is it possible to develop cross sections of the moisture contents given in this figure?	Cross sections (x, z) that show moisture would help illustrate some of the subsurface heterogeneities.	Please attempt to do this. Ecology would like to see this, even if it turns out that it does not make a good figure for this document.	JL							
RPP-ENV-58782, Rev 0	OPA3-5	3.1.9.2.6	3-101	10	BR		10/23/2018	The text states "The specific source of ^{99}Tc in the groundwater at WMA C has not been identified." This leaves the reader wondering if WMA C is acknowledged as the source.	A plume map for Tc-99 near WMA C would indicate that WMA C is the source.	Please revise this statement to remove the ambiguity about which facility is the source of Tc-99 in the groundwater below WMA C.	JL							
RPP-ENV-58782, Rev 0	OPA3-6	3.1.9.2.3	3-102	Figure 3-43	BR		10/23/2018	This figure begins in 2008 when Tc-99 was already elevated in some of the wells. It would be informative to begin the graph from the date when Tc-99 was first seen in these wells.		Please include older data on this figure to show when Tc-99 first appeared in the wells in and around WMA C.	JL							
RPP-ENV-58782, Rev 0	OPA3-7	3.2.1.2.2	3-116	31-39	BR		10/23/2018	The text states "Based on monitoring of the Prototype Hanford Barrier, it is expected that the barrier will continue to perform even after fires have burned off the vegetation...and extreme precipitation events...The lessons learned from the Prototype Hanford Barrier indicate that the cover design for the WMA C barrier will be very robust.." The WMA C barrier has not been designed, and if it resembles a RCRA C barrier it will be underdesigned relative to the Prototype Hanford Barrier.	The Hanford Barrier has 1 m of silt loam plus pea gravel (DOE/RL-2016-37), while the Modified RCRA C has only 50 cm (Figure 3-50); the Hanford Barrier has 1 m of lower silt, while the Modified RCRA C has only 50 cm of compacted topsoil; the Hanford Barrier has a layer of basaltic rip rap and basalt side slope, while the Modified RCRA C is missing this layer and slope. The total thickness of the Hanford barrier is over 4 meters, while the total thickness of the Modified RCRA C barrier is 1.7 m.	Include text that describes the Hanford Prototype barrier and compares the Modified RCRA C barrier against the Hanford Prototype barrier with regard to physical characteristics including types of layers and thicknesses. Discuss the functional differences between the Modified RCRA C barrier and the Hanford barrier.	JL							
RPP-ENV-58782, Rev 0	OPA3-8	3.2.2	3-120 - 3-154	General	BR		10/23/2018	There are post-retrieval data for most tanks now. That should allow for a comparison between predicted residuals and measured residuals. Discussion of how predictions compare with measured values would be useful and could replace a lot of the information in this section that discusses how values were calculated for unretrieved tanks.		Please discuss how predictions compared with measured values for the tanks with data.	JL							
RPP-ENV-58782, Rev 0	OPA3-9	3.2.2.1	3-121	41-44	BR		10/23/2018	The text mentions that pipelines are assumed to be only 5% full of waste. There are no pipeline residual waste sample data. Pipelines will not be grouted. Ecology has frequently requested a sensitivity case with pipelines 100% full, for the sake of bounding the possible risk associated with the pipelines. Ecology considers the pipelines to be a significant risk to inadvertent intruders.	Data in Table 4-3 for pipelines show that a 5-fold increase in the inventories for plutonium isotopes (for example) in the pipelines yield pipelines inventories for these contaminants higher than those for any tank.	Please add a sensitivity case assuming that the pipelines are 100% full. Also, ensure that inadvertent human intrusion into the pipelines will not occur.	JL							
RPP-ENV-58782, Rev 0	OPA3-10	3.2.2.3	3-122 - 3-147	General	BR		10/23/2018	It appears that the majority of inventories are based on values from 2014. The values should be updated to the latest values.		Update the inventory values in this section to the latest values.	JL							

RPP-ENV-58782, Rev 0	OPA3-11	3.2.2.3.1	3-126	23-24	DD		10/23/2018	Looks like "....upper 95% confidence interval...." should be "....upper 95% confidence limit....."	An interval includes lower and upper limits.	Replace "interval" with "limit" where this error occurs (e.g., Tables 3-16a, 3-16b).	JL							
RPP-ENV-58782, Rev 0	OPA3-12	3.2.2.4.1	3-141	Table 3-16a	SV		10/23/2018	Some of the cells in the table are blank. Table 3-13a gives residual inventory estimates for the various tanks, so it is not clear why there is missing information for the 95% confidence interval estimates in Table 3-16a.	Footnote b in the table indicates the reason is because concentrations for a specific radionuclide are less than the detection limit. However, if this is the case, then how were the estimates in Table 3-13a determined?	Clarify why some of the cells in the table are blank.	JL							
RPP-ENV-58782, Rev 0	OPA6-1	6.1	6-2	5-8	SV		10/23/2018	The text here lists various exposure pathways for the all pathways dose assessment. These pathways include human and animal ingestion of contaminated water and other media irrigated with contaminated water. Not included in this list is the fact that soil may become contaminated by irrigation with contaminated water, and subsequent root uptake by plants and incidental soil ingestion by humans and animals can contribute to total dose.		Please clarify if these pathways are considered, and if so, include in the text, and if not, explain why.	JL							
RPP-ENV-58782, Rev 0	OPA6-2	6.1	6-2	8-10	SV		10/23/2018	Analysis of the groundwater pathway includes a groundwater protection performance objective which limits concentrations in groundwater regardless of use.	From Chapter 7, Results of Analysis, it appears the groundwater concentrations are evaluated at 100 m downgradient, which is the point where human exposure is assumed to potentially occur. But this is not necessarily the point of maximum groundwater concentration, which is most likely to occur directly under the tanks.	Clarify here the location at which the groundwater protection objective is analyzed. The groundwater protection objective should be analyzed at the point of maximum groundwater concentration. Please clarify if this is the case, and if not, explain why.	JL							
RPP-ENV-58782, Rev 0	OPA6-3	6.2	6-6	Figure 6-2	BR		10/23/2018	This figure does not include the contamination in the subsurface from tanks leaks and spills but should be included in the figure.	Though the leaks and spills are not part of the scope of this document, they are part of the system and should be included in conceptual site model figures of the subsurface at WMA C.	Include leaks and spills in the conceptual site model diagrams, including Figure 6-2.	JL							
RPP-ENV-58782, Rev 0	OPA6-4	6.2	6-7	Figure 6-3	BR		10/23/2018	Alternative models I and II only differ by Hanford unit 3 inclusion in Alternative model II but not in I. However, there is no alternative model that includes the various sedimentary features (lamina, lenses, and other fine grained units) that may influence transport and moisture distribution, as Ecology has frequently requested.	Layers of varying texture in the subsurface create interfaces that can strongly influence where leaked and leached contamination in the subsurface ultimately comes to reside. It is important to know where the contamination is or will be in the future in order to design proper remedies.	Please address Ecology's concerns by including some semi-continuous layers in the subsurface, to see how they influence the extent (location) of contamination in the subsurface.	JL							
RPP-ENV-58782, Rev 0	OPA6-5	6.2.1	6-9	30-31	SV		10/23/2018	Explain here why release mechanisms are only considered for Tc-99 and uranium.	For example, later in the PA, it is evident that Tc-99 and uranium are some of the only contributors to radiation dose.	If this is the reason, then explain so.	JL							
RPP-ENV-58782, Rev 0	OPA6-6	6.2.2.1.2	6-31	14-16	BR		10/23/2018	The document discusses using annual recharge instead of considering episodic precipitation. Ecology's concern about episodic precipitation is a concern about underestimating annual recharge as a result of overestimating evapotranspiration. Episodic recharge changes the effectiveness of precipitation to generate recharge, with more recharge resulting from large precipitation events, rather than from that same amount of precipitation spread evenly over the course of a year.	Evapotranspiration is low during the winter, which means that a sizeable portion of the precipitation will go below the root zone and become recharge during the winter, though not in the summer growing season. Use of annual water balance parameter values, rather than monthly or more frequent water balance parameter values, would fail to account for the relatively large effectiveness of winter precipitation and the resulting higher annual recharge than would be calculated using annual water balance parameter values.	Revise the text to state: Following is a discussion of two assumptions that pertain to recharge (1) that net infiltration...., and therefore episodic precipitation events can be replaced by an annual recharge rate that is based on measurements of local monthly (or more frequent) water balance parameters.	JL							
RPP-ENV-58782, Rev 0	OPA6-7	6.2.3; 6.3.3.1	6-42; 6-135	40-42; 25-27	SV		10/23/2018	Dose conversion factors are taken from the DOE Standard Derived Concentration Technical Standard and EPA's FGR 12 (external radiation DCFs). The DOE standard only gives ingestion DCFs for ingestion of water.		Clarify what DCFs are used to calculate radiation dose from ingestion of other media, such as soil, produce, milk, meat, etc.	JL							
RPP-ENV-58782, Rev 0	OPA6-8	6.3.2.2.3	6-83	16-18	BR		10/23/2018	The document states "The impact of the side slopes on the overall recharge rate is expected to be relatively negligible."	The barriers that might be constructed have not been designed and the soil characteristics of the future barriers are unknown.	Cite the work in Last, et al. (2006) *Vadose Zone Hydrogeology Data Package for Hanford Assessments* , PNNL-14702, Rev.1, Section 4.5.4.	JL							
RPP-ENV-58782, Rev 0	OPA6-9	6.3.2.2.6	6-97 - 6-98	Table 6-11	CW		10/23/2018	The WMA C PA used the Kds from PNNL-17154 for most of the radionuclides but did not explain apparent assumptions made when using them, including: (1) Creating new vadose zone stratigraphic layers and combing others: <2mm material, backfill, Hanford H1/H3 and H2 that did not coincide with the designations or definitions in the PNNL report. (2) Using the "< 2mm" category combines a number of accepted grain sizes. Grain sizes within this range include medium sand, fine sand, very fine sand, silt, and clay (ISO 14688-1:2002). The PNNL report has very different values for sand vs silt for uncontaminated soil impacts and there are no silt values provided for WMA C sampled soils (i.e., to 24 m) in the PNNL report. (3) Using values from the PNNL report for soils to ~75 m depth with no explanation (the PNNL report only analyzed soils to 24 m). The PNNL report provides a table of values for sand and silt, specific to soils, which have not been impacted by waste. This appears to assume that vadose materials all the way to the groundwater have all been impacted by released waste.(4) Using only the stratigraphic layer <2mm material for transport modeling because for all others the "results of the screening indicated the element or contaminant does not arrive at the water table within 10,000 years." The PA indicates backfill, H1/H3 and H2 layers were evaluated for some contaminants.	continued, (5) Eliminating most transuranic elements with no discussion of chemical forms of those elements. (6) Using "intermediate, best" values from the PNNL report except for Tc, which used the "intermediate, min" value with no explanation. The minimum value provides for a more mobile contaminant case, but the same would be true for all the other radionuclides evaluated.(7) Using specific values for I-129 including those for backfill, H1/H3 and H2 soils which are not included in the PNNL report as referenced.	Please provide justifications for the assumptions ((1) through (7) in the comment) used for Kd values.	JL							
RPP-ENV-58782, Rev 0	OPA6-10	6.3.2.2.7	6-99 - 6-100	Table 6-12	BR		10/23/2018	Ecology has several comments and disagreements about parameters that are discussed in this table.	See our comments on geologic setting, source terms, and recharge.	Resolve the comments on parameters and then modify this table to be consistent with the resolutions.	JL							

RPP-ENV-58782, Rev 0	OPA6-11	6.3.2.6	6-134	Table 6-21	DD		10/23/2018	Table 6-21 shows maximum plant rooting depth at Hanford to be 9.8 ft for antelope bitterbrush. This likely underestimates rooting depth, as noted in our recent article on this subject (Lovtang et al. 2018. IEAM 14:442-226). Studies in the literature indicate that plant rooting depths are greater than 10 ft and several of these plant species are located on the Hanford Site. This represents a contaminant transport pathway which may impact human and eco receptors.	Here are some article excerpts: "Foxx et al. (1984b) reported that sagebrush averaged 248cm (8.1 ft) in shrub–steppe at Los Alamos, New Mexico, USA, ranging from 110 to 914cm (3.6–30 ft); rubber rabbitbrush (Ericameria nauseosa, formerly Chrysothamnus nauseosus) averaged 293cm (9.6 ft), ranging from 100 to 457cm (3.3–15 ft); and four-wing saltbush (Atriplex canescens) averaged 392cm (12.9 ft), ranging from 110 to 762 cm (3.6–25 ft). Big sagebrush and rabbitbrush are commonly found on Hanford's Central Plateau, as are several species of Atriplex. Fan et al. (2017) found that areas with coarse sand, gravel, rock fragments, and sandy–loam or sandy–silt soils had the deepest rooting depths (mean=409 cm [13.4 ft], SD=933 cm [30.6 ft]). Weeds that had been present on the prototype Hanford barrier (USDOE 1999), not associated with burning, include whitetop (Cardaria draba), which can have roots up to 365cm (12 ft) in its first growing season (Frazier 1943), and there are reports of root growth at much greater depths (Corns and Frankton 1952; Mulligan and Findlay 1974). Other weeds not associated with burning found on the barrier were field bindweed (Convolvulus arvensis), which can have roots as deep as 518 to 914cm (17–30 ft) below the surface (Kiltz 1930; Bakke et al. 1939; Holm et al. 1977), as well as Indian ricegrass (Oryzopsis hymenoides)."	Table 6-21 shows maximum plant rooting depth at Hanford to be 9.8 ft for antelope bitterbrush. This likely underestimates rooting depth, as noted in our recent article on this subject (Lovtang et al. 2018. IEAM 14:442-226). Please acknowledge that this pathway for contaminant transport may be complete (even with a 4.5 m [15 ft] cover).	JL							
RPP-ENV-58782, Rev 0	OPA6-12	6.3.2.6	6-134	7	DD		10/23/2018	Reference to "Figure 3-51" should be to "Figure 3-50."	References need to be accurate.	Replace "Figure 3-51" with "Figure 3-50."	JL							
RPP-ENV-58782, Rev 0	OPA6-13	6.3.3.1	6-137	Table 6-22	SV		10/23/2018	The fraction of time spent indoors and the fraction of time spent outdoors does not add up to an obvious quantity.	For example, they do not add up to 1.0, nor do they add up to the ratio of the Exposure Frequency (350 days) divided by the number of days in a year.	Clarify the significance of the values for these time fractions.	JL							
RPP-ENV-58782, Rev 0	OPA6-14	6.3.3.1.2, 6.3.3.1.3	6-142, 6-143	General	SV		10/23/2018	Why is tritium the only gaseous phase radionuclide discussed? Equations for other radionuclides are not given.		Please explain.	JL							
RPP-ENV-58782, Rev 0	OPA6-15	6.3.3.1.2	6-142	28-30	SV		10/23/2018	Can crop and livestock fodder also become contaminated as a result of sorption onto the crop or fodder from contaminated irrigation water (not just root uptake)?			JL							
RPP-ENV-58782, Rev 0	OPA6-16	6.3.3.1.6	6-148	General	SV		10/23/2018	Can sorption onto crops from contaminated irrigation water contribute to crop contamination?			JL							
RPP-ENV-58782, Rev 0	OPA6-17	6.4	6-158	Footnote 3	DD		10/23/2018	Re modeling and footnote 3, it's a stretch to interchange the terms, "validation" and "confidence." Supporting analyses can increase confidence in a model of this type but can never validate it, according to the customary definition provided (i.e., "comparison of model estimates with actual data at the space-time scales of interest").	Model predictions far into the future can never be validated in the conventional sense.	Re these types of models, use the term, "confidence" rather than "validation."	JL							
RPP-ENV-58782, Rev 0	OPA6-18	6.4.2	6-160	3	DD		10/23/2018	Kd values are provided in Table 6-5 (not Table 6-7, as stated).	References need to be accurate.	Replace "Table 6-7" with "Table 6-5."	JL							
RPP-ENV-58782, Rev 0	OPA7-1	7.1	7-3	Figure 7-1	SV	BR	10/23/2018	The maximum Tc-99 release rate from the pipelines occurs in the first few decades after closure, which is a time period when release from the tanks is very small in comparison. However, the release from the pipelines starts immediately after closure because it is assumed that the pipes themselves do not provide a barrier to transport (P 6-14). This assumption seems unrealistic. If more realistically it was assumed the pipelines did provide a barrier, the releases would occur later in time, and would add to the larger releases from the tanks at later times, resulting in larger total release. Thus, the assumption of no pipe barrier does not result in the maximum possible release.		Please include a case in which release from pipelines is delayed to coincide with tank releases.	JL							
RPP-ENV-58782, Rev 0	OPA7-2	7.1	7-3	7-3	SV		10/23/2018	U-238 is discussed. Why is U-234 omitted?	Usually, if U-238 is present, then U-234 is also present.	Include discussion of U-234.	JL							
RPP-ENV-58782, Rev 0	OPA7-3	7.1	7-4	19-20	SV		10/23/2018	Why are the releases for analytes other than Tc-99 and U-238 simpler? In other words, why are solubility limits and waste form degradation mechanisms not considered for other analytes?		Please explain.	JL							
RPP-ENV-58782, Rev 0	OPA7-4	7.2.1.1	7-7	17-19	SV		10/23/2018	The text indicates the first-arrival time can be estimated accurately by using the trend equation in Figure 7-6. It should be pointed out however that the arrival time is accurate only in the sense that Kd is known accurately.	An uncertainty of 0.15 in the Kd value corresponds to an uncertainty of 1000 years in arrival time.		JL							
RPP-ENV-58782, Rev 0	OPA7-5	7.2.1.1	7-8	12-16	SV	BR	10/23/2018	The analytes listed in the text for the different arrival times do not match the analytes listed in Table 7-2.	The text mentions I-129 while the table gives Sn isotopes for the sensitity/uncertainty time frame.	Please revise as necessary.	JL							
RPP-ENV-58782, Rev 0	OPA7-6	7.2.1.1	7-9	Table 7-9	BR		10/23/2018	The table lists carbon as a contaminant that could arrive at groundwater within 10,000 years. However, carbon (and C-14) comes in many forms. The form of carbon should be discussed.	Carbon can be in many inorganic and organic forms.	Add discussion of the form of carbon considered in Table 8-2.	JL							
RPP-ENV-58782, Rev 0	OPA7-7	7.2.1.2.1	7-11	Figure 7-7	BR		10/23/2018	Figure 7-7b should include a recent moisture log from a nearby WMA C location, to show how the modeled moisture compares with measured moisture with depth.	An example moisture log is in Figure 4-7 of RPP-RPT-46088, Rev. 1, *Flow and Transport in the Natural System of WMA C*. Others from in or near WMA C could be used.	Please add to this figure an available moisture log from a location near tank C-105.	JL							
RPP-ENV-58782, Rev 0	OPA7-8	7.2.1.2.2	7-17	16-23	SV		10/23/2018	Inclusion of the half lives in Table 7-2 would help in understanding the explanations here, as the text indicates some analytes would decay to insignificant quantities.		Please include half lives in Table 7-2.	JL							

RPP-ENV-58782, Rev 0	OPA8-1	8.1.3.1	8-7; 8-10	16-33; Table 8-3	BR		10/23/2018	The document states that 30 years would be adequate for mature shrub steppe to develop on disturbed areas. This is unlikely. The reference cited, Leisica et al (2007), discusses different sagebrush subspecies. Hanford has dominantly Wyoming big sagegbrush. The 32 year time period mentioned by Leisica et al (2007) is for other subspecies of big sagebrush: mountain big sagebrush and and basin big sagebrush. The same reference indicates that Wyoming big sagebrush takes "probably much more" than 30 years to recover after a fire. Furthermore, invasive species, including the pervasive cheatgrass in the Columbia Basin introduced in the 1800s, truly interfere with development of shrubs on disturbed lands. If a barrier is installed with silty material, planted with native species, and carefully tended and replanted after fires, a short restoration timeframe may be possible, but disturbed materials at Hanford would very likely not reach maturity in 30 years on their own. [It is well known in the Columbia Basin that shrub-steppe ecosystem areas are dramatically decreasing due to human disturbances].	In addition to potential human disturbances, wildfires (e.g., the Hanford site had 302 wildfires in the years 1990-2010 (USDOE, 2011)) can completely destroy sagebrush. Lesica, et al. (2007, Recovery of big sagebrush following fire in Southwest Montana, Rangeland Ecol. Manage. 60:261-269) found that Wyoming big sagebrush had only 2% recovery in 23 years after fires on plot studies in southwest Montana, and modeling suggested that full recovery for Wyoming big sagebrush after fires would be greater than 30 years "and probably much more." **Wyoming big sagebrush is the major subspecies of big sagebrush at Hanford (PNNL-13688), and it recovers more slowly than mountain big sagebrush and basin big sagebrush, which can both recover within 32 years** (Lesica, P, SV Cooper, G Kudray. 2007. Recovery of big sagebrush following fire in Southwest Montana, Rangeland Ecol. Manage. 60:261-269.). Finally, invasive species (e.g., cheatgress, a common invasive species after fire) result in higher recharge rates, at least 5 times greater than that of mature native shrub-steppe (Gee, GW, MJ Fayer, ML Rockhold, and MD Campbell. 1992. Variations in recharge at the Hanford Site, Northwest Science, 66(4):237-249). If cheatgrass establishes after a fire, it may take much longer for shrub steppe vegetation to develop (Norton, JB, TA Monaco, JM Norton, DA Johnson, TA Jones. 2004. Soil morphology and organic matter dynamics under cheatgrass and sagebrush-steppe plant communities. J. of Arid Environments 57:445-466; also, Pyke, DA, JC Chambers, JL Beck, ML Brooks, BA Mealor. 2016. Land uses, fire and invasion: exotic annual Bromus and human dimensions. In: Germino, MJ, JC Chambers, CS Brown (Eds.) Exotic brome-grasses in arid and semiarid ecosystems of the Western US: causes, consequences and management implications. Springer, New York, NY, USA, pp. 307-338).	Please include the following sensitivity case for recharge: New barrier planted with native species maintained during institutional control period: 0.5 mm/y recharge for 100 y; establishment of cheatgrass as an endpoint instead of mature shrub steppe, with recharge of 25 mm/y or greater due to cheatgrass, fires and human disturbance (such as construction activities), after the 100-y institutional control period, out to 1000 y.	JL							
RPP-ENV-58782, Rev 0	OPA9-1	9.0	9-2	Table 9-1	SV		10/23/2018	Explain why none of the exposure scenarios include the 'consumption of contaminated well water' pathway. Where are the folks running the Rural Pasture, Suburban Garden, or Commercial Farm getting their drinking water from? It seems that to be conservative, drinking water should come from the contaminated well water.			JL							
RPP-ENV-58782, Rev 0	OPA9-2	9.1	9.4	10-12	BR		10/23/2018	The text states "The only credible potential intrusion event at WMA C is a drilling intrusion, owing to the depth of the wastes (greater than 5 m after the modified RCRA Subtitle C barrier is put in place)..." There is currently no formal commitment to place a 5 m barrier over WMA C, and the large amount and low availability of material for a barrier will most likely make this prohibitive. Other intrusion methods are very possible and need to be considered.	For example, excavation for buildings, roads, utilities, and irrigation (such as pipelines from the river across the site to points beyond the site), could all exhume material from the top 15 feet (possibly deeper). Disposal of the excavated material would be needed or humans could contact the excavated materials.	Discuss expsorure associated with inadvertent intrusion by typical human activities such as excavation beyond 100 y. Design a barrier that will prevent human intrusion by all typical means beyond 100 y.	JL							
RPP-ENV-58782, Rev 0	OPA9-3	9.4	9-25; 9-27	Table 9-7; Figure 9-6	BR		10/23/2018	While the DOE limits for intruder exposures are 100 and 500 mrem/y, the CERCLA criteria include an upper cancer risk limit of 1E-04, which corresponds to roughly 10 to 15 mrem/y. It appears that the acute well driller accessing a pipeline would have a dose/risk exceeding this CERCLA limit.	See Table 9-7 and Figure 9-6 for the first 200 years.	Adjust the remedy for WMA C to prevent this type of intrusion.	JL							
RPP-ENV-58782, Rev 0	OPAD-1	D4.2	D-32	General	BR		10/23/2018	This section needs to be revised to pull together the source terms, including the vadose zone, the tank waste, pipelines, ancillary equipment, and groundwater.	The title of this section is 'Nature and Extent of Contamination,' but it neglects key source terms (the vadose zone inventory and groundwater contamination) and, therefore, does not give the actual nature and extent of contamination.	Provide a figure of Tc-99 vs. time with all of the source terms, similar to Figure D-9.	JL							
RPP-ENV-58782, Rev 0	OPAF-1	Appendix F	F-1	28-30	DD		10/23/2018	Text states, "In the absence of anthropogenic recharge, field-measured moisture contents are assumed to be in equilibrium with natural recharge." This assumption is unlikely.	An assumption of equilibrium is unsupported, given that hydrogeologic processes and properties are often event-driven and better characterized by nonequilibrium (e.g., rainfall, field capacity).	Describe the associated uncertainty or eliminate the assumption of equilibrium between field moisture contents and natural recharge.	JL							